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CAREER PERFORMANCE OF MARGINALLY SCHOLASTIC GRADUATES OF THE AIR FORCE INSTITUTE OF TECHNOLOGY'S RESIDENT MASTER'S DEGREE PROGRAMS

THESIS

Michael D. Zwart, B.S.
Captain, USAF

AFIT/GSM/LSY/84S-33

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Wright-Patterson Air Force Base, Ohio

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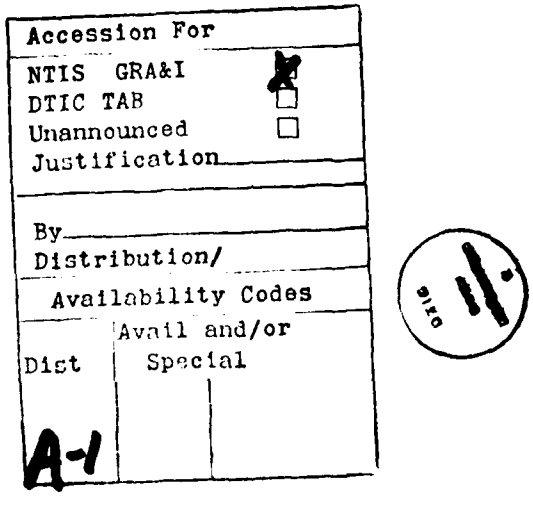

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CAREER PERFORMANCE OF MARGINALLY SCHOLASTIC GRADUATES OF THE AIR FORCE INSTITUTE OF TECHNOLOGY'S RESIDENT MASTER'S DEGREE PROGRAMS

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Systems Management

Michael D. Zwart, B.S.
Captain, USAF

September 1984

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Abstract

The Air Force invests substantial amounts of time, money, and resources to sponsor officers in full-time graduate programs at the Air Force Institute of Technology. This thesis project was an effort to determine the correlation between graduate grade point average and career performance to determine if the Air Force receives a lower return on its investment from those officers who graduate with marginal grade point averages. The measures of career performance analyzed were time to promotion, selection rate for promotion, and service time in the Air Force.

The sample population was divided into marginal and non-marginal groups and t-tests were performed comparing the groups for each measure of career performance. Simple linear regressions comparing graduate grade point average to promotion time and service time were performed to determine the correlation coefficients. Background variables of academic major, source of commission, and aeronautical rating were added to grade point average and multiple regression analyses performed with promotion and service time.

The results showed that no significant difference existed between the marginal and non-marginal groups for promotion time or for service time. There was a difference in promotion rates but only for promotion to the rank of lieutenant colonel. The regression results indicated an inverse relationship between graduate grade point average and both promotion and service time. In both cases, however, the correlation was weak and a very small percentage of the variations in promotion and service times were explained.

CAREER PERFORMANCE OF MARGINALLY SCHOLASTIC GRADUATES OF THE AIR FORCE INSTITUTE OF TECHNOLOGY'S RESIDENT MASTER'S DEGREE PROGRAMS

I. Introduction

The pursuit of an advanced degree is believed to be an important factor in a successful career. Many organizations, including the Air Force, encourage their employees to pursue masters' degrees. "Education as a lifelong process is an accepted objective of the armed forces" (5:73). Often, employees are provided some form of tuition assistance and time away from work to attend graduate classes.

Some organizations sponsor their employees in full-time graduate studies. In these cases, the employer pays the employee's salary as well as tuition, books, and other fees. The employee's job is to attend graduate school full time. The Air Force sponsors full-time graduate students at both civilian institutions and the Air Force Institute of Technology (AFIT) at Wright-Patterson Air Force Base, Ohio. Officers who are selected to attend AFIT pursue masters' degrees in management, engineering, and related

disciplines. The need for AFIT programs was addressed by Charles Duncan, Deputy Secretary of Defense, to the AFIT graduates of December 1978:

> Because of our commitment to technology, the quality of defense-oriented advanced technical and scientific education such as AFIT provides here and you have received here, is essential to the Department of Defense. Because of your unique education, there will be a continuing solid demand for Air Force resident school graduates throughout the R&D community [4:31-32].

General Lew Allen, Jr., then Air Force Chief of Staff, also recognized the need for AFIT and its graduates in a speech given at AFIT on November 17, 1979:

> As we enter the decade of the 1980s, the role of AFIT has never been more vital. It plays a critical role in our efforts to maintain within our ranks the core of well-educated personnel essential to meeting the military and scientific challenges in an age of accelerating technological change. To succeed, we must aggressively recruit qualified personnel for our AFIT programs and convince policy-makers in the Administration and the Congress of the critical role graduate education plays in the life of the Air Force [3:5-6].

The Air Force and other organizations invest substantial amounts of money, time, and other resources to sponsor full-time graduate programs; therefore, they are concerned with getting a return on their investment in the from of increased performance on the job. This raises the question of whether performance in graduate school, as measured by graduate grade point average (GGPA), has any

correlation with career performance after graduation from a master's degree program.

Problem Statement

According to AFIT's 096CR financial report for 1981, the average economic cost to the Air Force for sponsoring graduate students in the Engineering School was $82,892.68 per student and for the School of Systems and Logistics the cost was $67,258.66 per student (2:1). (The difference occurs because Engineering degree programs are eighteen months long while those degree programs in the School of Systems and Logistics were twelve months long in 1981. They are now fifteen months long.) The Air Force has a highly selective admissions policy to select officers to attend AFIT on a full-time basis. Thus, the Air Force tries to select only those officers who will perform well both at AFIT and in their careers after graduation from AFIT. The Air Force Institute of Technology requires a minimum cumulative grade point average of 3.0 on a 4.0 scale to graduate (1:39,172). Between 1977 and 1982, over 10 percent of the 2,170 AFIT graduates had cumulative graduate grade point averages below 3.20 (14:86). Since the Air Force makes a substantial investment in the officers attending AFIT, it needs to be determined whether there are any significant differences in career performance after graduation between those officers with marginal

scholastic performance (operationally defined as less than 3.20) and those officers who graduate with GGPAs of 3.20 or above.

Background

Several research projects have been conducted to measure the correlation between graduate grade point average (GGPA) and various measures of career performance. Most of the research has dealt with graduates of business schools and the most frequently measured criterion of career performance is compensation in the form of earnings and salary. Some researchers have found significant correlations between graduate grade point average and career performance, while others claim there is no correlation, as will be shown in the remainder of this section.

In 1951, Jepsen investigated the relationship between grades and salaries of 797 Fresno State College graduates. He found no significant correlation between salary and grades (10:627-628).

Williams and Harrell initiated a longitudinal study in 1964 of graduates of the Stanford School of Business from 1961 to 1964. Although they found no correlation between overall GGPA or required course grade point average and earnings, they did find that the grade point average from optional courses was correlated with earnings (15:166-167). In 1972, Harrell again looked at the 1961-1964 Stanford

graduates, but this time he used the second year GGPA as the predictor of earnings. The second year courses were mostly optional and a positive correlation between second year GGPA and earnings was found (7:527). Harrell concluded that the grade point average from the optional courses was a valid predictor of earnings because it was a measure of the student's motivation and interest (8:491).

In 1974, Harrell and Harrell followed up on the earnings of 366 Stanford graduates from the 1961-1964 period at five and ten years after graduation. Second year grade point average was used to predict compensation, job satisfaction, and job success. The graduates in the High GGPA category (the top 25 percent) had significantly higher earnings and felt more successful than those with lower second year grade point averages at both the five and ten year points. No correlation was found between second year GGPA and job satisfaction (9:11). In 1977, Harrell and others did a follow-up study on 266 Stanford graduates from 1961-1964. Second year grade point average was used to predict compensation at five and ten years after graduation. The second year grade point average showed a correlation coefficient of .44 at the five year point and .32 for the ten year compensation (6:638-639). A correlation coefficient of 1.0 is perfect linear correlation and a coefficient of 0.0 means there was no correlation between the variables.

In 1977, Pfeffer took a random sample of 215 MBA and 156 bachelor's degree graduates of the University of California, Berkeley. He found no evidence that grades could significantly predict compensation -- either current salary or starting salary (13:704).

Only one study dealt with military careers and it looked at enlisted rather than officer careers. In 1975, Kantor and Guinn looked at the differences between high school graduates and non-graduates in the Air Force. The sample population consisted of 20,705 males who enlisted between April 1967 and March 1968. The measures of career success used were completion of basic training, completion of technical training, and completion of the initial four year commitment to the Air Force (11:7). A higher percentage of high school graduates completed all three measures of career success (11:11).

Summary

Although several studies have been conducted which investigated the relationship between graduate grade point average and various measures of career success, none were found that dealt with measures of military officer career success or with Air Force Institute of Technology graduates. The measures used for enlisted personnel (11:7) are not appropriate measures of officer career success and the widely used criterion of compensation is not a direct

measure of officer career success since pay is primarily based on rank and years of service. It is not clear whether graduate grade point average is a valid predictor of career success. The evidence seems to say that overall graduate grade point average or required course average is not correlated with career success, but that second year grade point average or optional course average is correlated with some measures of career success, usually compensation.

Research Objective

The objective of this study is to investigate the correlation between Air Force Institute of Technology Air Force Officer graduates' grade point average (GGPA) and several measures of career success or performance. Specifically, the career performance of those officers who perform at marginal scholastic levels (GGPA < 3.20) is compared to the career performance of the other AFIT graduates. Although the Officer Effectiveness Reports (OERs) would seem an obvious measure of career performance, it was not used for two reasons. First, the OERs are so inflated that it is felt that not enough variation in ratings would be observed for the OER to act as a distinguishing measure of officer career performance. Second, due to the sensitive nature of any information which goes before a promotion board (including the OERs),

the data on Officer Effectiveness Reports is not readily available. The measures of career performance which are analyzed for correlation with graduate grade point average are time to promotion to the next rank, selection rate for promotion, and months of Air Force service before separation or retirement. Additional background variables of academic major, source of commission, and aeronautical rating are combined with GGPA to see if the correlations improve and to explain what percentage of the variations in the performance measures are attributable to graduate grade point average.

Research Hypotheses

In investigating the correlation of GGPA with career performance, the following research hypotheses were used to guide the statistical analyses.

1. The time to promotion to the next rank for marginal scholastic AFIT graduates is statistically longer than the time to promotion for AFIT graduates with GGPAs of 3.20 or above. It is speculated that officers who are capable of attaining higher GGPAs may possess greater ability and more initiative than those officers who perform at marginal scholastic levels. If this is true, the promotion times should be longer for the marginal AFIT graduates.

2. The selection rate for promotion is statistically lower for marginal scholastic AFIT graduates than for the other AFIT graduates. Again, if higher GGPAs are indicative of greater ability and initiative, the selection rates should be lower for the marginal graduates.

3. Marginal scholastic performers remain in the Air Force (service time) statistically longer than AFIT graduates with GGPAs of 3.20 or greater. The rationale for this hypothesis is that officers who have high GGPAs from AFIT are more likely to be recruited for employment in civilian companies and will therefore have shorter service times than the marginal graduates who might have a greater tendency to make the Air Force a career.

4. The combination of GGPA with background variables such as academic major at AFIT, source of Air Force commission, and aeronautical rating can improve the correlation with time to promotion and/or Air Force service time. In order to get a clearer understanding of the relationship of GGPA with promotion time and service time, correlation coefficients will be calculated. Then the background variables will be added and the new correlation coefficients will be calculated. Usually, adding more variables to predict an attribute of a sample population increases the ability to predict, which means the correlation will improve.

II. Methodology

Subjects

The subjects of this study include all graduates from the Air Force Institute of Technology's resident master's degree programs from 1977 through 1982 for whom the master's degree is the highest academic degree currently held. Any graduates who had attained a doctorate were not included in the sample population so that any career influences due to the doctorate would not effect the results of investigating the correlation between academic performance on a master's degree and career performance. The total sample population was 1,610 graduates, and all information was collected on over 99 percent of the total. Subjects were not included if their graduate grade point averages were missing from the records.

Data Collection

A partial data base existed from a 1983 AFIT thesis (14) which included data on graduate grade point average (GGPA), rank at the time of graduation from an AFIT master's program, source of military commission, and master's degree program for the AFIT graduates from 1977 to 1982 inclusive. Promotion dates and aeronautical rating

were obtained through the ATLAS data base maintained by the Military Personnel Center, Randolph AFB, Texas for all subjects still on active duty in the Air Force and for whom the master's degree is the highest academic code in their personnel records.

For those subjects no longer on active duty in the Air Force, separation dates and aeronautical rating were obtained from the DESIRE data base maintained by AFIT at Wright-Patterson AFB, Ohio. Promotion dates were not available for those subjects no longer on active duty. All data was the current information as of May 22, 1984.

Data Analysis

Variable Names. For convenience, the variable names which will be encountered throughout this thesis are defined here.

GGPA	Graduate grade point average
PROMTIME	Promotion time in months
SERTIME	Service time in months
RATED	Officer has an aeronautical rating (Pilot, Navigator, etc.)
COMCODE	Source of officer commission code (USAF Academy, Reserve Officer's Training Corps, or Officer's Training School)
MAJOR	Academic major for AFIT master's
MARG	Marginal scholastic graduates, GGPA < 3.2
NON-MARG	AFIT graduates with GGPA $\geq$ 3.2
SCHOOL	Either Engineering or Systems and Logistics

Table I

No Promotion Opportunity Criteria

(Current Information as of May 22, 1984)

If the current rank and the rank at graduation are	Then the subject had no opportunity for promotion if date of rank is later than
Second Lieutenant	May 22, 1982
First Lieutenant	May 22, 1982
Captain	May 22, 1976
Major	May 22, 1980
Lieutenant Colonel	May 22, 1980

No Promotion Opportunity. The first step in reviewing the promotion data on the sample population was to eliminate subjects who did not have an opportunity to be promoted since graduating from AFIT. The criteria used to identify those subjects not having an opportunity to be promoted since graduation from AFIT is based on the normal times to promotion to each rank and is presented in Table I.

Promotion on Time. Officers promoted to the rank of first lieutenant are usually promoted exactly two years after they became second lieutenants. Officers promoted to captain are usually promoted exactly two years from the date they became first lieutenants. The time to promotion for the subjects who were either first lieutenants or

captains was calculated. Those who were promoted exactly two years after making their prior rank were identified as having been promoted on time. If any promotion time was longer than two years, the subject was identified as being promoted late. Promotion to first lieutenant or captain in less than two years since their prior date of rank is not possible.

Time to Promotion. The time to promotion, in months, was then calculated for those subjects who had been promoted to the rank of major, lieutenant colonel, or colonel since graduation from the Air Force Institute of Technology (AFIT). The calculated promotion times were then added to the data base.

Passed Over for Promotion. Those officers who had an opportunity to be promoted within normal times since graduation from AFIT but were not promoted to the next higher rank were identified as passed over for promotion. The criteria used to identify passed over subjects is given in Table II.

Service Time. For those AFIT graduates no longer on active duty in the Air Force, promotion data was not available. Their service time, the time they served on active duty, was calculated using the difference between their separation data and the date they entered the Air Force. This calculated service time, in months, was added to the data base.

Table II

Passed Over for Promotion Criteria

(Current Information as of May 22, 1984)

If the current rank is	Then the subject was passed over for promotion if date of rank is earlier than
Captain	May 22, 1976
Major	May 22, 1980
Lieutenant Colonel	May 22, 1980

Statistical Tests

Tests on Promotion Time. The first research hypothesis suggests that the promotion times for marginal scholastic AFIT graduates are longer than the promotion times for non-marginal graduates. The promotion times vary according to rank; therefore, the sample population was subdivided according to rank. The statistical test used to test the hypothesis was the t-test. A t-test calculates the probability that the sample means for two groups are significantly different (12:267). A t-test was done for each rank which had a significant number of cases and in which a variation in promotion time was possible. The t-test compared the mean PROMTIME for the MARG and the NON-MARG groups for each rank tested. The t-tests were performed using the T-TEST subprogram of the Statistical Package for the Social Sciences (SPSS) (12:267-275). It

was not assumed that the variances for each group were equal; therefore, all probabilities reported are based on separate estimates of each group's variance.

In order to further investigate the correlation between GGPA and PROMTIME, a simple linear regression was done to calculate the percentage of variation in PROMTIME which could be explained by GGPA within each rank category tested with the t-test. The background variables of MAJOR, SCHOOL, COMCODE, and RATED were then added to see if the explained portion of PROMTIME could be improved over that explained by GGPA alone. Since MAJOR, SCHOOL, COMCODE, and RATED are all nominal variables, they were included in the regression analysis by the use of dummy variables. Dummy variables make it possible to include nominal variables in a regression analysis even though at least interval-scaled variables are required (12:373-383). The analysis which calculated the effect of GGPA, MAJOR, COMCODE, and RATED on PROMTIME was done using a procedure known as stepwise multiple regression. Both the simple and multiple regression were done using the REGRESSION subprogram of SPSS (12:320-367).

Tests for Selection Rate. The second hypothesis stated that the selection rate for promotion for the MARG group is lower than the rate for the NON-MARG graduates. For each rank, the subjects who were promoted were divided into MARG and NON-MARG, and those who were passed over for

the same rank were identified and divided into MARG and NON-MARG groups. The percentage of subjects promoted out of the total number eligible in each group was calculated. This percentage is the selection rate for MARG and NON-MARG graduates. A t-test was also performed on the mean GGPAs of the promoted versus the passed over subjects.

Tests on Service Time. The third research hypothesis proposes that subjects in the MARG group have longer service times than those in the NON-MARG group. Again, a t-test was used to calculate the probability that the mean SERTIME for the MARG group was significantly longer than the mean SERTIME for the NON-MARG group for those graduates identified as no longer on active duty in the Air Force.

In order to gain more insight into the relationship between GGPA and SERTIME, a simple linear regression was done to calculate the percentage of variation in SERTIME that could be explained by GGPA. As with time to promotion, background variables were added to GGPA and a multiple regression analysis performed. The variables of MAJOR, SCHOOL, COMCODE, and RATED were included in the analysis in an attempt to increase the amount of variation in SERTIME which could be explained. Both the simple and multiple regressions were performed using the REGRESSION subprogram of SPSS (12:320-367).

The results of all tests are presented in Chapter III.

III. Results

This chapter is divided into three sections. The first section contains a breakdown of those subjects who were included in the final data base on which statistical tests were run and which subjects were not considered in the final data base. Demographic information is presented on the subjects in the final data base. The second section contains the results of the statistical tests performed to test the research hypotheses concerning promotion times and promotion selection rates. Section three presents the results of the statistical tests done to test the hypothesis concerning service time.

Data Base Composition

The total sample population contained 1,610 subjects. Of that number, 1,568 were still on active duty in the Air Force and 42 were separated from the Air Force. Since promotion data was not available on those subjects separated from the Air Force, two separate data bases were created to facilitate the analyses.

Active Duty Data Base. The first data base consists of the 1,568 subjects still on active duty in the Air Force. Of that number, data is available for all but

eight subjects so that over 99 percent of the population is included. Since not all of those subjects had an opportunity to be promoted since graduating from AFIT, the subjects identified as not having an opportunity for promotion, according to the criteria given in Chapter II, were eliminated from the active duty data base. The breakdown, by rank, for those eliminated is shown in Table III.

The large number of captains not having a promotion opportunity is due to the time frame of the sample population and the length of time it takes for a captain to be promoted to major. The normal time for a captain to be promoted to major is approximately eight years after the date he or she made captain. Since the sample population included those officers who graduated between 1975 and 1982, and since 72 percent of the sample subjects were captains at the time they graduated, it is not surprising that 58 percent (651) of those captains had less than eight years of time in the rank of captain and were therefore identified as having no promotion opportunity.

The next group of subjects identified are those first lieutenants and captains who were promoted on time, that is, exactly two years after making either second lieutenant or first lieutenant, respectively. The number of subjects either promoted late or passed over for promotion to first lieutenant and captain are identified. The results are given in Table IV.

TABLE III

Active Duty Subjects Eliminated
Due to No Promotion Opportunity

Rank	Number Eliminated
First Lieutenant	10
Captain	651
Major	24
Lieutenant Colonel	1
Total	686

TABLE IV

Breakdown of Promotions to
First Lieutenant and Captain

Category	Number Identified
To First Lieutenant:	
Promoted on Time	92
Promoted Late	0
Passed Over	
To Captain:	
Promoted on Time	193
Promoted Late	0
Passed Over	0
Total	285

Since all 285 first lieutenants and captains eligible for promotion were promoted on time, no distinction could be made in their promotion rate or promotion time since all promotion times were exactly two years. For this reason, these 285 subjects were also eliminated from the data base on which statistical analyses were performed.

The original active duty data base consisted of 1,568 subjects. Eight were eliminated because of missing information. Also not considered, as discussed above, were 686 subjects who had no promotion opportunity and 285 subjects promoted to first lieutenant or captain. This resulted in a final active duty data base (FADDB) of 589 subjects. The demographic information on this final data data base for the independent variables used in this thesis is given in Tables V - IX. The commission codes in Table VIII and the major codes in Table IX are the dummy variables used in the stepwise multiple linear regression.

Separated Data Base. The second data base consists of the 42 subjects who had separated from the Air Force since graduating from AFIT. Data was missing on two subjects, resulting in a final separated data base (FSDB) with 40 cases. The demographic information on the FSDB is given in Tables X - XIII.

TABLE V

AFIT GGPA Distribution of FADDB

GGPA Category	Absolute Frequency	Relative Frequency (%)
3.00 - 3.09	35	5.9
3.10 - 3.19	31	5.3
3.20 - 3.29	33	5.6
3.30 - 3.39	47	8.0
3.40 - 3.49	85	14.4
3.50 - 3.59	69	11.7
3.60 - 3.69	72	12.2
3.70 - 3.79	83	14.1
3.80 - 3.89	73	12.4
3.90 - 4.00	61	10.4
Total	589	100.0
MEAN = 3.569	STD DEV = .264	

TABLE VI

Promotion Category Distribution of FADDB

Promotion Category	Absolute Frequency	Relative Frequency (%)
Promoted to:		
Major	476	80.8
Lt Col	70	11.9
Colonel	5	0.8
Passed Over for:		
Major	3	0.5
Lt Col	35	5.9
Colonel	0	0.0
Total	589	100.0

TABLE VII

Rated vs. Non-Rated Distribution of FADDB

Category	Absolute Frequency	Relative Frequency (%)
Rated	331	56.2
Non-Rated	258	43.8
Total	589	100.0

TABLE VIII

Source of Commission Distribution of FADDB

Category	Absolute Frequency	Relative Frequency (%)	Comm. Code
USAF Academy	121	20.5	C1
ROTC	241	40.9	C2
OTS	214	36.3	C3
Other	13	2.2	C4
Total	589	100.0	

TABLE IX

AFIT Major Distribution for FADDB

Academic Major	Absolute Frequency	Relative Frequency (%)	Major Code
School of Systems and Logistics			
Logistics Management	157	26.7	M1
Facilities Management	37	6.3	M2
International Logistics	19	3.2	M3
Transportation Management	1	.2	M4
Acquisition Management	16	2.7	M5
Systems Management	64	10.9	M6
Engineering Management	4	.7	M7
Procurement Management	15	2.5	M8
Cost Analysis	13	2.2	M9
Subtotal	326	55.3	
School of Engineering			
Nuclear Engineering	17	2.9	M10
Operations Research	21	3.6	M11
Guidance and Control	6	1.0	M12
Astronautical Engineering	17	2.9	M13
Electrical Engineering	52	8.8	M14
Computer Science	21	3.6	M15
Systems Engineering	11	1.9	M16
Strategic/Tactical Sciences	42	7.1	M17
Electro-Optics	8	1.4	M18
Aeronautical Engineering	43	7.3	M19
Space Operations	2	.3	M20
Engineering Physics	23	3.9	M21
Subtotal	263	44.7	
Total	589	100.0	

TABLE X

AFIT GGPA Distribution for FSDB

GGPA Category	Absolute Frequency	Relative Frequency (%)
3.00 - 3.09	2	5.0
3.10 - 3.19	3	7.5
3.20 - 3.29	0	0.0
3.30 - 3.39	10	25.0
3.40 - 3.49	5	12.5
3.50 - 3.59	5	12.5
3.60 - 3.69	2	5.0
3.70 - 3.79	2	5.0
3.80 - 3.89	3	7.5
3.90 - 4.00	8	20.0
Total	40	100.0
MEAN = 3.551	STD DEV = .286	

TABLE XI

Rated vs. Non-Rated Distribution for FSDB

Category	Absolute Frequency	Relative Frequency (%)
Rated	12	30.0
Non-Rated	28	70.0
Total	40	100.0

TABLE XII

Source of Commission Distribution for FSDB

Source	Absolute Frequency	Relative Frequency (%)
USAF Academy	5	12.5
ROTC	11	27.5
OTS	23	57.5
Other	1	2.5
Total	40	100.0

TABLE XIII

AFIT Major Distribution for FSDB

Academic Major	Absolute Frequency	Relative Frequency (%)
School of Systems and Logistics		
Logistics Management	7	17.5
Facilities Management	5	12.5
International Logistics	1	2.5
Systems Management	1	2.5
Procurement Management	7	17.5
Subtotal	21	52.5
School of Engineering		
Guidance and Control	2	5.0
Astronautical Engineering	2	5.0
Electrical Engineering	4	10.0
Computer Science	4	10.0
Systems Engineering	1	2.5
Electro-Optics	1	2.5
Aeronautical Engineering	4	10.0
Engineering Physics	1	2.5
Subtotal	19	47.5
Total	40	100.0

Promotion Time and Promotion Rate Results

The results of the statistical analyses concerning the correlation of graduate grade point average (GGPA) with promotion time (PROMTIME) and promotion rate (PROMRATE) are presented according to officer rank.

First Lieutenant and Captain. As shown previously in Table IV, all 92 of the subjects who were first lieutenants and all 193 subjects who were captains were promoted on time, which is exactly two years after making their previous rank. Since all subjects were promoted with the same promotion time, no distinction could be made between the MARG and NON-MARG groups. Also, since no subjects were promoted late or passed over for promotion, the promotion rate for both the MARG and NON-MARG groups was 100 percent. Again, no distinction between the groups was found based on GGPA.

Major. The FADDB contained 479 subjects who had an opportunity to be promoted to the rank of major. Of that number, 476 were promoted to major and 3 were passed over for promotion. Since the number passed over for promotion was so small, no analysis was performed regarding differences in promotion rates based on GGPA. The GGPA distribution for the 476 subjects promoted to major since graduating from AFIT is shown in Table XIV.

The results of the t-test performed to determine if any significant difference existed in the mean time for

TABLE XIV

GGPA Distribution for Subjects Promoted to Major

GGPA Category	Absolute Frequency	Relative Frequency (%)
3.00 - 3.09	26	5.5
3.10 - 3.19	26	5.5
3.20 - 3.29	26	5.5
3.30 - 3.39	42	8.8
3.40 - 3.49	70	14.7
3.50 - 3.59	59	12.4
3.60 - 3.69	54	11.3
3.70 - 3.79	62	13.0
3.80 - 3.89	58	12.2
3.90 - 4.00	53	11.1
Total	476	100.0
MEAN = 3.569	STD DEV = .263	

TABLE XV

T-Test Results for Promotion Time of Majors

Group	Number of cases	Mean PROMTIME	Standard Deviation	2-tailed Probability
GGPA < 3.2	52	94.54	10.54	.818
GGPA $\geq$ 3.2	424	94.89	8.53	
Total	476	94.85	8.76	

promotion to major between the MARG and NON-MARG groups are given in Table XV. As can be seen from the results, there is no significant difference in promotion time to major between the groups at any reasonable level of significance.

Since no distinction in PROMTIME could be made between the MARG and NON-MARG groups, a simple linear regression was performed to determine the correlation between GGPA and PROMTIME for all subjects promoted to major. The results are shown here.

Correlation Coefficient	- .0858
Number of Cases	476
Significance	.061
Percent Variation Explained	.736

The negative coefficient supports the hypothesis that higher GGPAs tend to result in lower times to promotion, but the effect is not very significant since only .736 percent of the variation in promotion time can be explained by GGPA alone. The next step was to add the background variables of MAJOR, SCHOOL, COMCODE, and RATED to the regression analysis and again look at the percentage of variation in PROMTIME which could be reasonably explained. The stepwise multiple regression was done allowing variables to enter the equation if their F-values were 1.0 or greater. This means that the amount of variation explained by the variable entering the equation at least

compensates for the loss of one degree of freedom in the error term of the regression. A summary of the regression is given in Table XVI and the weighting factors for each variable in the regression equation are shown in Table XVII. The M and C variables refer to the academic major codes and source of commission codes, respectively, which were given in Tables VIII and IX.

As shown in Table XVI, even with the addition of background variables to GGPA, only 4.582 percent of the variation in promotion time to major could be explained. GGPA now can explain 1.048 percent of the variation in promotion time compared to .736 percent when used by itself. The negative weighting factor of -3.8180 for GGPA again indicates that GGPA and PROMTIME vary inversely even though GGPA only accounts for a small percentage of the variation in PROMTIME.

Lieutenant Colonel. The FADDB contained 105 subjects who had an opportunity to be promoted to lieutenant colonel. Of that number, 70 were promoted and 35 were passed over for promotion using the criterion previously given in Table II. The GGPA distributions for the promoted and passed over subjects are given in Tables XVIII and XIX. The t-test results of PROMTIME for the promoted lieutenant colonels are shown in Table XX. The results show that there is no significant difference in promotion time to lieutenant colonel between the MARG and NON-MARG groups.

TABLE XVI

Regression Summary of Promotion Time for Majors

Step #	Variable Entered	Signif-icance	R Squared	Change in R Squared	Overall Signif-icance
1	M2	.046	.00840	.00840	.046
2	M1	.039	.01734	.00894	.016
3	GGPA	.025	.02783	.01048	.004
4	M8	.059	.03517	.00735	.002
5	RATED	.127	.03995	.00478	.002
6	M12	.180	.04363	.00368	.002
7	M18	.301	.04582	.00219	.002

TABLE XVII

Weighting Factors for Promotion Time to Major

Variable	Weighting Factor	95 Percent Confidence Interval
M2	4.3465	1.1914 , 7.5016
M1	2.4127	0.5702 , 4.2551
GGPA	- 3.8180	- 6.8085 , - 0.8275
M8	4.9243	- 0.0770 , 9.9257
RATED	1.2581	- 0.3432 , 2.8594
M12	- 4.8732	-11.8648 , 2.1185
M18	- 3.2047	- 9.2864 , 2.8770
Constant	106.8222	96.1628 , 117.4816

TABLE XVIII

GGPA Distribution for Subjects
Promoted to Lieutenant Colonel

GGPA Category	Absolute Frequency	Relative Frequency (%)
3.00 - 3.09	4	5.7
3.10 - 3.19	2	2.9
3.20 - 3.29	2	2.9
3.30 - 3.39	1	1.4
3.40 - 3.49	11	15.7
3.50 - 3.59	9	12.9
3.60 - 3.69	10	14.3
3.70 - 3.79	14	20.0
3.80 - 3.89	12	17.1
3.90 - 4.00	5	7.1
Total	70	100.0
MEAN = 3.614	STD DEV = .244	

TABLE XIX

GGPA Distribution for Subjects
Passed Over for Lieutenant Colonel

GGPA Category	Absolute Frequency	Relative Frequency (%)
3.00 - 3.09	3	8.6
3.10 - 3.19	3	8.6
3.20 - 3.29	4	11.4
3.30 - 3.39	3	8.6
3.40 - 3.49	3	8.6
3.50 - 3.59	1	2.9
3.60 - 3.69	6	17.1
3.70 - 3.79	6	17.1
3.80 - 3.89	3	8.6
3.90 - 4.00	3	8.6
Total	35	100.0
MEAN = 3.517	STD DEV = .294	

TABLE XX

T-Test Results for Promotion Time of Lieutenant Colonels

Group	Number of cases	Mean PROMTIME	Standard Deviation	2-tailed Probability
GGPA < 3.2	6	54.67	25.30	.788
GGPA $\geq$ 3.2	64	51.73	5.72	
Total	70	51.99	8.77	

Again, a simple linear progression was performed to determine the strength of the correlation between GGPA and PROMTIME for all subjects promoted. The results were as follows:

Correlation Coefficient	- .0065
Number of Cases	70
Significance	.479
Percent Variation Explained	.004

The background variables of MAJOR, SCHOOL, COMCODE, and RATED were added to GGPA and a multiple regression analysis was run. The correlation between GGPA and PROMTIME turned out to be so weak that GGPA was not significant enough to enter into the regression equation.

Of the 105 subjects eligible for promotion, twelve were in the MARG group. Of those twelve, six were promoted and six were passed over for promotion to lieutenant colonel. The selection rate data is given in Table XXI.

Another way to compare the numbers is to look at the percentages of promoted and passed over subjects who were in the MARG and NON-MARG groups. The percentage of MARG subjects is twice as high for the passed over subjects than it is for the promoted group as shown in Table XXII.

TABLE XXI

Selection Rate for Promotion to Lieutenant Colonel

Group	Number Eligible	Number Promoted	Selection Rate (%)
GGPA < 3.2	12	6	50.0
GGPA $\geq$ 3.2	93	64	68.8
Total	105	70	66.7

TABLE XXII

Marginal and Non-Marginal Breakdown of Lieutenant Colonels

Group	Number MARG	Percent MARG	Number NON-MARG	Percent NON-MARG
Promoted	6	8.57	64	91.43
Passed Over	6	17.14	29	82.86
Total	12	11.43	93	88.57

The last test performed to look at the effect of GGPA on selection for promotion was a t-test of the mean GGPAs for the promoted and passed over groups. The results shown in Table XXIII indicate that the mean GGPA for the promoted lieutenant colonels is greater than the mean GGPA for the passed over group, and that the difference is significant at the .095 level. For a one-tailed hypothesis that promoted GGPA is greater than passed over GGPA, the probability is .047.

Colonel. Only three subjects had been promoted to the rank of colonel and none had been passed over. No statistical tests could be performed on such a small sample.

Service Time Results

The starting point in the investigation of the correlation between GGPA and SERTIME was a t-test of the mean SERTIME for each group. The results given in Table XXIV show no significant difference in mean service time between the MARG and NON-MARG groups.

To test for any correlation between GGPA and SERTIME, a simple linear regression was done. The results shown below show a fairly significant negative correlation. This tends to support the hypothesis that officers with lower GGPAs stay in the Air Force longer than those with high GGPAs.

TABLE XXIII

T-Test Results of GGPA for Promoted vs. Passed Over Lieutenant Colonels

Group	Number of cases	MEAN GGPA	Standard Deviation	2-tailed Probability
Promoted	70	3.61	.244	.095
Passed Over	35	3.52	.294	
Total	105	3.58	.264	

TABLE XXIV

T-Test Results of Service Time and GGPA

Group	Number of cases	Mean SERTIME	Standard Deviation	2-tailed Probability
GGPA < 3.2	5	176.80	102.71	.887
GGPA $\geq$ 3.2	35	169.60	82.17	
Total	40	170.50	83.51	

Correlation Coefficient	- .2707
Number of Cases	40
Significance	.091
Percent Variation Explained	7.328

The simple regression shows that 7.328 percent of the variation in SERTIME was explained by GGPA. The background variables of MAJOR, SCHOOL, COMCODE, and RATED were then added to GGPA and a stepwise multiple linear regression analysis performed to look for an increase in the amount of variation which could be explained. As with the multiple regression on promotion time to major, variables were entered into the regression equation if their F-values were 1.0 or greater. The M and C variables refer to the academic majors and source of commission codes given in Tables VIII and IX. A summary of the multiple regression is shown in Table XXV and the weighting factors for each variable are in Table XXVI.

As shown in Table XXV, the multiple regression equation explains 84.45 percent of the variation in SERTIME. GGPA accounts for 2.724 percent of the variation in SERTIME with a significance of .044. It is interesting to note that the variable C3, source of commission at OTS, explains 52.24 percent of the service time variation all by itself.

TABLE XXV

Regression Summary of Service Time

Step #	Variable Entered	Signif-icance	R Squared	Change in R Squared	Overall Signif-icance
1	C3	.000	.52240	.52240	.000
2	SCHOOL	.001	.64490	.12251	.000
3	M3	.002	.73079	.08589	.000
4	C1	.044	.76058	.02979	.000
5	GGPA	.044	.78782	.02724	.000
6	M1	.081	.80683	.01901	.000
7	M16	.075	.82535	.01852	.000
8	M13	.128	.83812	.01277	.000
9	M15	.276	.84450	.00638	.000

TABLE XXVI

Weighting Factors for Service Time

Variable	Weighting Factor	95 Percent Confidence Interval
C3	118.5072	88.1621 , 148.8522
SCHOOL	- 66.2198	- 97.7762 , -34.6633
M3	-118.5219	-201.2951 , -35.7487
C1	66.3183	22.9253 , 109.7114
GGPA	- 54.4351	-103.9532 , - 4.9169
M1	40.2161	.2864 , 80.1458
M16	82.7707	.9454 , 164.5960
M13	52.5201	- 7.2902 , 112.3303
M15	25.7801	- 21.6842 , 73.2444
Constant	307.5012	128.6468 , 486.3555

IV. Conclusions and Recommendations

A Review of the Research Hypotheses

The first hypothesis stated that the promotion time for AFIT graduates with graduate grade point averages less than 3.2 was longer than the promotion time of graduates with higher GGPAs. For first lieutenants and captains, all promotions were on time at exactly two years; consequently, there was no distinction in promotion time based on GGPA. For majors, the mean promotion time for the MARG group (GGPA < 3.2) was actually less than the mean for the NON-MARG (GGPA $\geq$ 3.2) cases, however, the difference was not statistically significant. The results of a simple and multiple linear regression lend some support to the stated hypothesis. The regressions tested the correlation of GGPA as a whole (not grouped into MARG and NON-MARG) on the promotion time to major. Both regressions resulted in negative coefficients for GGPA which means that promotion time and GGPA vary inversely, which supports the research hypothesis. The support is not very strong, however, since less than 1 percent of the variation in promotion time could be explained and even that small amount was not statistically significant. The results of comparing mean promotion time for lieutenant colonels in the MARG and

NON-MARG groups did show the times in the predicted direction, but again, the difference in promotion time was statistically insignificant.

The second research hypothesis stated that the selection rate for promotion for MARG graduates was less than the rate for NON-MARG graduates. All subjects eligible for promotion to first lieutenant and captain were selected and therefore, no distinction can be made between the MARG and NON-MARG selection rate for them. The only group which had enough people passed over for promotion in it to allow statistical analyses to be performed was the lieutenant colonel eligibles. The selection rate for the MARG group was 50 percent while for the NON-MARG group it was 68.8 percent. The results of a t-test on the mean GGPAs of the promoted and passed over groups support the hypothesis. The mean GGPA for the promoted lieutenant colonels was higher than the mean GGPA for the passed over subjects and the difference was significant at the .047 level for the hypothesis that mean GGPA for those promoted is greater than the mean GGPA for those passed over for promotion.

The third research hypothesis stated that the MARG group had longer service times than the NON-MARG group. The t-test did show that the mean service time for MARG graduates was slightly longer than the mean for NON-MARG subjects but the difference was not statistically

significant. Again, the regression analyses testing the correlation of GGPA as a whole on service time lend some support to the hypothesis. The simple linear regression showed that 7.3 percent of the variation in service time could be explained by GGPA at a significance level of .091 and that GGPA and service time do vary inversely. Interestingly, the multiple regression analysis could explain 84.5 percent of the variation in service time. Just knowing whether an officer was commissioned at Officer's Training School explained 52.2 percent of the variation in service time and knowing whether he or she graduated from the School of Engineering or the School of Systems and Logistics could explain another 12.3 percent.

Conclusions

The justification for this research was that the Air Force makes a large investment in the officers selected to attend the Air Force Institute of Technology in pursuit of a master's degree. In Chapter I, the economic costs were cited as being $82,892.68 for each graduate of the School of Engineering and $67,258.66 for each graduate from the School of Logistics. If a significant difference in career performance existed between graduates who performed at marginal scholastic levels compared to the rest of the AFIT graduates, the Air Force would not be getting as good a return on its investment in those officers who performed

marginally at AFIT. Based on the career performance measures used in this study, the Air Force appears to be receiving an equal return on its investment from both the marginal and non-marginal graduates. No significant differences between marginal and non-marginal scholastic performers could be found in promotion time or service time; however, the selection rate to lieutenant colonel for marginal graduates was lower than the selection rate for the rest of the AFIT graduates. Unfortunately, the selection rates to lieutenant colonel were the only ones which could be calculated from the sample population because the number of non-selected cases for the other ranks was too small to perform any significant analysis.

Recommendations

Due to the fairly recent time frame of the sample population, 1975-1982 graduates, many subjects were eliminated from the data base. This resulted in not having enough subjects in some of the promotion categories, especially the passed over for promotion category, for a more complete statistical analysis to be performed. It is therefore suggested that the study be replicated for a larger population and one in which the majority of the population has had an opportunity to be promoted since graduating from AFIT.

Additional variables could also be used to predict career performance. Although it was stated in Chapter I that the Officer Effectiveness Report (OER) ratings were inflated, if they can be obtained they might provide some insight into performance. Other variables which might be considered are the level of endorsement on the OER, job titles, and level of assignments.

It is also recommended that the correlation between graduate grade point average and career performance be investigated for Air Force officers who earned master's degrees from sources other than the Air Force Institute of Technology. Possible groups include those officers who earned their master's degrees from an AFIT sponsored full-time degree program at a civilian institution, officers who earned their master's degree from part-time study at a civilian institution, and officers who earned their master's degree from part-time study at the Air Force Institute of Technology.

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The Air Force invests substantial amounts of time, money, and resources to sponsor officers in full-time graduate programs at the Air Force Institute of Technology. This thesis project was an effort to determine the correlation between graduate grade point average and career performance to determine if the Air Force receives a lower return on its investment from those officers who graduate with marginal grade point averages. The measures of career performance analyzed were time to promotion, selection rate for promotion, and service time in the Air Force.

The sample population was divided into marginal and non-marginal groups and t-tests were performed comparing the groups for each measure of career performance. Simple linear regressions comparing graduate grade point average to promotion time and service time were performed to determine the correlation coefficients. Background variables of academic major, source of commission, and aeronautical rating were added to grade point average and multiple regression analyses performed with promotion and service time.

The results showed that no significant difference existed between the marginal and non-marginal groups for promotion time or for service time. There was a difference in promotion rates but only for promotion to the rank of lieutenant colonel. The regression results indicated an inverse relationship between graduate grade point average and both promotion and service time. In both cases, however, the correlation was weak and a very small percentage of the variations in promotion and service times were explained.